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# JERS/SEASAT SAR Level 1 Products ENVISAT and GEOTIFF/TIFF FORMAT SPECIFICATIONS



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|---|---|
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| 1.5 | May 2014 | Derived from JIPF-E-G-SPEC.v.1.5, updated for SEASAT GEC product and ngEO product packaging |
| 1.6 | October 2014 | Minor editorial following final release of SEASAT-IPF v1.3.6 |

# Contents

# Tables

# 1 Introduction

## 1.1 Purpose of This Document

This document defines the ENVISAT and GEOTIFF/TIFF format of the L1 products generated from JERS/SEASAT SAR sensor data by the ESA JERS SAR Instrument Processing Facility (IPF).

## 1.2 Background

The JERS/SEASAT SAR IPFs have been developed by ESA to provide ready user access to the ESA archives of JERS and SEASAT SAR data acquired over Europe during the L-band missions JERS(1992-1998) and SEASAT(1978)

A range of SAR image data products are available, comparable in style and resolution to those available from the ESA ERS-1 and ERS-2 SAR sensors. JERS products are available to users in a range of formats – CEOS, ENVISAT-style and GEOTIFF/TIFF; for SEASAT, L1 products are currently only available as CEOS (PRI, SLC) or GEOTIFF (GEC).

This document provides a definition of the product formats used for ENVISAT-style and GEOTIFF/TIFF. CEOS formatted products are described in [RD-1].

A JERS level 0 (unprocessed signal data) product is not provided in ENVISAT-style format; instead a level 0 product is provided in a CEOS format, compatible with level 0 JERS products currently distributed by JAXA. It is thought that users interested in focusing the L0 data are unlikely to wish to develop a new data input interface.

The SEASAT level 0 product is provided in an historic MDA format (an early CEOS-style format). Details of both level 0 products are described in [RD-1].

The ENVISAT-style format is provided to facilitate access to the data by software tools developed for analysis of ENVISAT ASAR data.

Not all ENVISAT product fields defined by [AD-3] are applicable to the JERS mission, and some fields are inapplicable to the JERS SAR IPF; these fields are blank or null-filled as appropriate and are documented in this specification. None of the information in these voided fields is thought to be relevant to users interested in analyzing the L1 products.

# 2 Documentation

## 2.1 Applicable Documents

[AD-1] Products Naming Standard Convention GMGT-MMAN-EOPG-TN-13-0005
[AD-2] EO Parameter Codes V1.0 (PGSI-GSEG-EOPG-TN-07-0001)
[AD-3] ENVISAT-1Product Specifications (Volume 8, Issue 4, Rev. B, PO-RS-MDA-GS-2009)
[AD-4] Annex A to [AD-3] "Product Data Conventions"

## 2.2 Reference Documents

[RD-1] JERS/SEASAT SAR Products CEOS Format Specifications, JSIPF-CEOS-SPEC v1.0 May 2014
[RD-2] ESA ASAR Product Handbook http://envisat.esa.int/handbooks/asar/
[RD-3] GEOTIFF specifications http://www.remotesensing.org/geotiff/geotiff.html
[RD-4] EO SIP Packaging for SEASAT, ESA tbd
[RD-5] EO SIP Packaging for JERS, ESA tbd

## 2.3 Acronyms and Abbreviations

| Acronym/Abbreviation | Significance |
|---|---|
| ADC | Analog to Digital Conversion |
| ADS | Annotated Data Set |
| ADSR | Annotated Data Set Record |
| ASAR | Advanced Synthetic Aperture Radar |
| ASCII | American Standard Code for Information Interchange |
| CCT | Computer-Compatible Tape |
| CEOS | Committee on Earth Observations Satellites |
| DS | Data Set |
| DSD | Data Set Descriptor |
| DSR | Data Set Record |
| ESA | European Space Agency |
| GADS | Global Annotation Data Set |
| GEC | Geocoded Ellipsoid Corrected (product) |
| GMT | Greenwich Mean Time |

| | |
|---|---|
| H/H | Horizontal/Horizontal |
| Hz | Hertz |
| ISLR | Integrated Side Lobe Ratio |
| LADS | Localisation ADS (Map related ADSR) |
| MDS | Measurement Data Set |
| MDSR | Measurement Data Set Record |
| MPH | Main Product Header |
| MR | Medium Resolution |
| PRF | Pulse Repetition Frequency |
| PSLR | Peak to Side-Lobe Ratio |
| SAR | Synthetic Aperture Radar |
| SBT | Satellite Binary Time |
| SPH | Specific Product Header |
| SQ | Summary Quality |
| SR/GR | Slant Range to Ground Range |
| SWST | Sampling Window Start Time |
| TIFF | Tagged Image File Format |
| UTC | Universal Time Coordinates |
| UPS | Universal Polar Stereographic |
| UTM | Universal Transverse Mercator |

## 2.4 Document Overview

This document is presented with four principal sections.

In section 3 we describe the JERS SAR products available in ENVISAT & GEOTIFF/TIFF format.

In section 4 we describe the overall structure of the products and details on the products naming and packaging.

In section 5 we present tables detailing the ENVISAT product contents, annotated as appropriate with regard to any features unique to the JERS SAR products.

In section 6 we present details on the GEOTIFF/TIFF product contents.

# 3 JERS SAR Level 1 Products in ENVISAT/GEOTIFF/TIFF format

## 3.1 Data Processing Background

All the JERS SAR level 1 products are generated directly from focusing of low-level datasets extracted from ESA WILMA JERS telemetry archives, using archived satellite orbit state vectors and time correlation records. The state vector and time correlation data is not available as auxiliary characterization files, and consequently no characterization files are included as ADSRs in the ENVISAT-style formatted products.

SAR focusing is undertaken using a range-Doppler processing architecture adapted to allow generation of scenes of extended size along track without loss of focus or georeferencing precision.

All detected products are generated from post-processing of a standard Level 1 precision image, which is then averaged and decimated to generate intermediate resolution products, or geocoded, or both.

## 3.2 Product Types

A range of products with differing characteristics are available, and, with the exception of the Single Look Complex product which is only available in an ENVISAT-style format, products are available in either an ENVISAT-style or a TIFF/GEOTIFF format. The GEOTIFF format is an extension to the TIFF Format, incorporating additional tags and data defining projection and georeferencing information[1]. Image pixel values for (16-bit) TIFF/GEOTIFF products are identical to the pixel values in ENVISAT-style format. Table 3-1 summarises the JERS/SEASAT SAR products available, and a brief description is provided below.

**Table 3-1 JERS/SEASAT SAR Level 1 products available in ENVISAT/GEOTIFF/TIFF format**

| Product ID | Product Type | Available Formats | Parameter | Value |
|---|---|---|---|---|
| **JSA_IMP_1P** | Level 1 Precision Image | ENVISAT<br>TIFF - 1 byte/pixel<br>TIFF - 2 bytes/pixel | Pixel size | 12.5 * 12.5 m |
| | | | Projection | Ground range in SAR coordinates |
| | | | Processing Bandwidth | 4 * 300 Hz overlapped looks, covering a total 1000Hz Doppler bandwidth. |
| | | | Side-lobe reduction | Hanning Weighting = 0.75 (<-21dB PSLR) |
| **JSA_IMS_1P** | Level 1 Single Look Complex | ENVISAT | Pixel size | As determined per ADC rate and PRF |
| | | | Projection | Slant range in SAR coordinates |
| | | | Processing Bandwidth | 1000 Hz Doppler bandwidth single look. |
| | | | Side-lobe reduction | Not Applied |

[1] GEOTIFF formatted products are acceptable as images to non GEOTIFF-equipped TIFF readers

| | | | | |
|---|---|---|---|---|
| **JSA_IMM_1P** | Level 1 Medium Resolution Image | ENVISAT<br>TIFF - 1 byte/pixel<br>TIFF - 2 bytes/pixel | Pixel size | 75 * 75m |
| | | | Projection | Ground range in SAR coordinates |
| | | | Resolution | Derived from IMP by spatial averaging and decimation by factors of 6 in range and azimuth respectively.<br>Spatial resolution ~150m, ENL>75 |
| **JSA_IMG_1P** | Level 1 Ellipsoid Geocoded Precision Image adjusted for representative vertical datum | ENVISAT<br>GEOTIFF - 1 byte/pixel<br>GEOTIFF - 2bytes/pixel | Pixel size | 12.5 * 12.5 m |
| | | | Projection | UTM or UPS |
| | | | Processing Bandwidth | 4 * 300 Hz overlapped looks, covering a total 1000Hz Doppler bandwidth |
| | | | Side-lobe reduction | Hanning Weighting = 0.75 (<-21dB PSLR) |
| **JSA_MRG_1P** | Level 1 Ellipsoid Geocoded Medium Resolution Image | ENVISAT<br>GEOTIFF - 1 byte/pixel<br>GEOTIFF - 2 bytes/pixel | Pixel size | 75 * 75m |
| | | | Projection | UTM or UPS |
| | | | Resolution | Derived from IMP by spatial averaging and decimation by factors of 6 in range and azimuth respectively and then regridded.<br>Spatial resolution ~150m, ENL>40 |

| Product ID | Product Type | Available Formats | Parameter | Value |
|---|---|---|---|---|
| **SEA_GEC_1P** | SEASAT Level 1 Ellipsoid Geocoded Precision Image adjusted for representative vertical datum | TIFF - 2 bytes/pixel | Pixel size | 12.5 * 12.5 m |
| | | | Projection | UTM or UPS |
| | | | Processing Bandwidth | 6 * 250 Hz overlapped looks, covering a total 1200Hz Doppler bandwidth. |
| | | | Side-lobe reduction | Hanning Weighting = 0.75 (<-21dB PSLR) |

### 3.2.1 Level 1 Precision Image (JSA_IMP_1P)

The JSA_IMP_1P product is comparable to the ESA PRI/IMP images generated for ASAR and ERS platforms. It is a ground range projected detected image in zero-Doppler SAR coordinates, with a 12.5 metre pixel spacing. It has four overlapping looks in Doppler covering a total bandwidth of 1000Hz, with each look covering a 300Hz bandwidth. Sidelobes reduction is applied to achieve a nominal PSLR of less than -21dB. Data processed to the JSA_IMP_1P specification provides the basis for production of all other detected products.

### 3.2.2 Level 1 Single Look Complex Image (JSA_IMS_1P)

The JSA_IMS_1P product is comparable to the ESA SLC/IMS images generated for ASAR and ERS platforms. It is a slant-range projected complex image in zero-Doppler SAR coordinates. The data is sampled in natural units of time in range and along track, with the range pixel spacing corresponding to the reciprocal of the platform ADC rate and the along track spacing to the reciprocal of the PRF. Data is processed to an unweighted Doppler bandwidth of 1000Hz, without sidelobes reduction. The product is suitable for interferometric, calibration and quality analysis applications.

### 3.2.3 Level 1 Medium Resolution Image (JSA_IMM_1P)

The JSA_IMM_1P product is comparable to the ESA IMM images generated for the ASAR platforms. It is a ground range projected detected image in zero-Doppler SAR coordinates, with a 75 metre pixel spacing and enhanced radiometric resolution. The image is generated by power averaging blocks of 6*6 pixels of a product generated to JSA_IMP_1P specification, and has an effective number of looks > 75. The reduced data volume and high contrast make this an attractive product for many applications.

### 3.2.4 Level 1 Ellipsoid Geocoded Precision Image (JSA_IMG_1P)

The JSA_IMG_1P product is generated by geocoding (regridding to a map projection) of data processed to the JSA_IMP_1P product specification. Products may be generated in either UTM or UPS map coordinates, with output pixel spacing at 12.5 metres. Geocoding is undertaken on the approximation that all image points lie on the surface of the WGS84 ellipsoid adjusted for a local representative vertical datum; it should be noted that mapping distortions will occur as a consequence of terrain relief.

### 3.2.5 Level 1 Ellipsoid Geocoded Medium Resolution Image (JSA_MRG_1P)

The JSA_MRG_1P product is generated by geocoding of data processed to the JSA_IMM_1P product specification. As with JSA_IMG_1P, products may be generated in either UTM or UPS projections, but with a pixel spacing of 75 metres.

### 3.2.6 Level 1 Ellipsoid Geocoded Precision Image (SEA_GEC_1P)

The SEA_GEC_1P product is generated by geocoding (regridding to a map projection) of data processed to the SEA_PRI_1P product specification. Products may be generated in either UTM or UPS map coordinates, with output pixel spacing at 12.5 metres. Geocoding is undertaken on the approximation that all image points lie on the surface of the WGS84 ellipsoid adjusted for a local representative vertical datum; it should be noted that mapping distortions will occur as a consequence of terrain relief.

## 3.3 Browse Products

Associated with any Level 1 product is a Browse Product. The product is a power averaged and decimated representation of the main product and is provided in a North-oriented PNG format.

## 3.4 Calibration

All products are radiometrically calibrated, and are numerically scaled such that a Beta0 value of 0dB corresponds to a product digital number (DN) value of 682.3. Calibration was undertaken using data from October 1995 and is thought to be accurate to ~0.2dB at that epoch; however calibration drift may arise in products generated from other periods of the JERS mission. Radiometric calibration for SEASAT data is however very approximate.

## 3.5 Product Size

Products are not generated to a fixed size. A “standard” JERS scene is nominally ~ 80 by 80 Km and a SEASAT scene is nominally 100 by 100Km..

# 4 Product Naming and Packaging

## 4.1 Product Naming Convention and Packaging

All products are named with a filename according to [AD-1]. All product filenames have a name stub with the format:

Product_namestub = <platform>_<OPER>_<product_ID>_<Start_time>_<End_time>_<abs_orbit>_<track_number>_<frame_node_number>_<crc_code>

with a filename extension varying according to the file type, and where the fields in the name stub have the following significance:

| Field | Size in Characters | Description |
|---|---|---|
| <platform> | 3 | JE1 (JERS-1) or SE1 (SEASAT) |
| <product_ID> | 10 | product code JSA_RAW_0P |
| <Start_time> | 15 | YYYYMMDDTHHMMSS |
| <End_time> | 15 | YYYYMMDDTHHMMSS |
| <abs_orbit> | 6 | Absolute orbit number |
| <track_number> | 4 | Track number |
| <frame_node_number> | 4 | Node number at centre of image frame |
| <crc_code> | 4 | 4-digit random hex string as unique identifier |

For example a JERS L1 product might have the name stub JE1_OPER_JSA_IMG_1P_1998022T101733_1998022T101747_001234_0123_4567_E1DE

All ESA JERS and SEASAT products are packaged according to ESA EOSIP specifications [RD-06], [RD-07].

The EOSIP packaging provides:

- The L1 product

  For SEASAT the EnviSAT/TIFF/GEOTIFF formatted product file is contained within a tarfile (TAR), for consistency with the SEASAT CEOS SIP packaging. For JERS-1 the product is just provided as a file.

- Metadata and a quicklook Browse Product, as a zipfile (.ZIP)

  Metadata is provided in XML format in accordance with the schemas defined in [RD-04], [RD-05].

Metadata comprises :
- SIPInfo (with the filename extension ".SI.XML")
- EarthObservation metadata (with the filename extension ".MD.XML")
- qualityReport metadata (with the filename extension ".QR.XML")
- browseReport (with the filename extension ".BI.XML) (for L1 image data products)

The browse image is supplied as a North-oriented PNG file (with the filename extension ".BI.png")

All the data in the SIP package is provided in a zipfile (.ZIP).

# 5 Product File Structure for ENVISAT format

## 5.1 Introduction

The product file structure for the ENVISAT format is straightforward. It consists of a series of concatenated records of various types and sizes. The header of the product contains two fixed length records, the MPH and the SPH, which describe the contents of the product.

The SPH contains a sequence of data set descriptor fields, which provide linkage, defining the byte offset and size of the subsequent records included in the product. Table 5-1 below summarises the overall file structure of the ENVISAT format for all products.

**Table 5-1 Product File Structure for ENVISAT format**

| Record | Number of Records |
|---|---|
| MPH | 1 |
| SPH | 1 |
| SQ ADS | 1 |
| Main Processing Parameter ADS | 1 |
| Doppler Centroid ADS | Variable (Time[2]) |
| Slant Range to Ground Range Conversion ADS | Variable (Time) |
| Chirp parameter ADS | Variable (Time) |
| Antenna Elevation ADS | Variable (Time) |
| Geolocation Grid ADS (LADS) | Variable (Space[3]) |
| Map Projection Parameters GADS | 1[4] |
| Measurement Data Set (MDS) | Variable |

[2] Time variable ADSRs are updated every 12 sec of image.
[3] LADS are nominally updated along track for every 10Km of image. However for compatibility with some 3rd party software, the first and last LADS ADSRs are aligned with the first and last image record, and the record spacing between LADS ADSRs consequently varies by +/- 1 image record – but are calculated at the specified azimuth positions.
[4] Only for ellipsoid geocoded products.

All products have the same structure, with the distinction (as with other ASAR formatted products) that the Map Projection Parameters GADS are only provided for the ellipsoid geocoded products (JSA_IMG_1P and JSA_MRG_1P).

Not all fields in all records are applicable to the JERS SAR data, but the physical layout is maintained in common with standard ASAR formatted products to allow compatibility with existing software analysis facilities. Where relevant such fields are null or blank filled, and are annotated as such in the tables presented in section 5.2.

All binary data is provided in “big-endian” format, with bytes ordered from most significant to least significant.

## 5.2 Product Contents for ENVISAT format

The tables below define the contents of individual records and fields. The ENVISAT data format involves a mixture of binary and ASCII data and the “Data Type” column for each field describes its content using the following abbreviations:

### Table 5-2 Product Contents for ENVISAT format

| Variable Type | Binary Abbreviation | ASCII format | ASCII Abbreviation |
|---|---|---|---|
| Character | uc (unsigned char) | Single ASCII character | uc |
| | sc (signed char) | SXXX | Ac |
| 2-byte integer | ss: signed short integer | SXXXXX | As |
| | us: unsigned short integer | | |
| 4-byte integer | sl: signed long integer | SXXXXXXXXXX | Al |
| | ul unsigned long integer | | |
| 8-byte integer | sd: signed long long integer | SXXXXXXXXXXXXXXXXXXX | Ad |
| | ud: unsigned long long integer | | |
| 4-byte single precision floating point | Fl | SX.XXXXXXXXESXX | Afl |
| 8-byte double precision floating point | d0 | SX.XXXXXXXXXXXXXXXXXXESXXX<br>S.XXXXXX<br>SXXXX.XXXXXX<br>SXXXXXXX.XXX | Ado<br>Ado06<br>Ado46<br>Ado73 |

### 5.2.1 Main Product Header (MPH)

**Table 5-3 Main Product Header (MPH)**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **PRODUCT=** | keyword | 8 | 8*uc |
| | quotation mark | - | 1 | uc |
| | Product File name | - | 62 | 62*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 2 | **PROC_STAGE=** | keyword | 11 | 11*uc |
| | X | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 3 | **REF_DOC=** | keyword | 8 | 8*uc |
| | quotation mark | - | 1 | Uc |
| | Reference Document Describing Product | - | 23 | 23*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 4 | **Spare** | - | 40 | 40*uc |
| | newline character | terminator | 1 | uc |
| 5 | **ACQUISITION_STATION=** | keyword | 20 | 20*uc |
| | quotation mark | - | 1 | uc |
| | Acquisition Station ID | - | 20 | 20*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 6 | **PROC_CENTER=** | keyword | 12 | 12*uc |
| | quotation mark | - | 1 | uc |
| | Processing Center ID | - | 6 | 6*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 7 | **PROC_TIME=** | keyword | 10 | 10*uc |
| | quotation mark | - | 1 | uc |
| | UTC Time of Processing | UTC | 27 | 27*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 8 | **SOFTWARE_VER=** | keyword | 13 | 13*uc |

| | | | | |
|---|---|---|---|---|
| | quotation mark | - | 1 | uc |
| | Software Version number of processing software | - | 14 | 14*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 9 | **Spare** | - | 40 | 40*uc |
| | newline character | terminator | 1 | uc |
| 10 | **SENSING_START=** | keyword | 14 | 14*uc |
| | quotation mark | - | 1 | uc |
| | UTC start time of data sensing | UTC | 27 | 27*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 11 | **SENSING_STOP=** | keyword | 13 | 13*uc |
| | quotation mark | - | 1 | uc |
| | UTC stop time of data sensing | UTC | 27 | 27*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 12 | **Spare** | - | 40 | 40*uc |
| | newline character | terminator | 1 | Uc |
| 13 | **PHASE=** | keyword | 6 | 6*uc |
| | Set to 2 (Operational phase) | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 14 | **CYCLE=** | keyword | 6 | 6*uc |
| | Cycle | - | 4 | as |
| | newline character | terminator | 1 | uc |
| 15 | **REL_ORBIT=** | keyword | 10 | 10*uc |
| | Relative orbit number | - | 6 | as |
| | newline character | terminator | 1 | uc |
| 16 | **ABS_ORBIT=** | keyword | 10 | 10*uc |
| | Absolute orbit number | - | 6 | as |
| | newline character | terminator | 1 | uc |
| 17 | **STATE_VECTOR_TIME=** | keyword | 18 | 18*uc |
| | quotation mark | - | 1 | uc |
| | UTC of source JERS state vector [5] | UTC | 27 | 27*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |

[5] This is the source state vector as provided by the PFM – it may be at the ascending node or may be local to the dataset.

| | | | | |
|---|---|---|---|---|
| 18 | **DELTA_UT1=** | keyword | 10 | 10*uc |
| | UT1-UTC, set to +0.0 | s | 8 | uc |
| | <s> | units | 3 | Ado06 |
| | newline character | terminator | 1 | uc |
| 19 | **X_POSITION=** | keyword | 11 | 11*uc |
| | X Position in Earth-Fixed reference | m | 12 | Ado73 |
| | <m> | units | 3 | 3*uc |
| | newline character | terminator | 1 | uc |
| 20 | **Y_POSITION=** | keyword | 11 | 11*uc |
| | Y Position in Earth-Fixed reference | m | 12 | Ado73 |
| | <m> | units | 3 | 3*uc |
| | newline character | terminator | 1 | uc |
| 21 | **Z_POSITION=** | keyword | 11 | 11*uc |
| | Z Position in Earth-Fixed reference | m | 12 | Ado73 |
| | <m> | units | 3 | 3*uc |
| | newline character | terminator | 1 | uc |
| 22 | **X_VELOCITY=** | keyword | 11 | 11*uc |
| | X velocity in Earth fixed reference | m/s | 12 | Ado73 |
| | <m/s> | units | 5 | 3*uc |
| | newline character | terminator | 1 | uc |
| 23 | **Y_VELOCITY=** | keyword | 11 | 11*uc |
| | Y velocity in Earth fixed reference | m/s | 12 | Ado73 |
| | <m/s> | units | 5 | 3*uc |
| | newline character | terminator | 1 | uc |
| 24 | **Z_VELOCITY=** | keyword | 11 | 11*uc |
| | Z velocity in Earth fixed reference | m/s | 12 | Ado73 |
| | <m/s> | units | 5 | 3*uc |
| | newline character | terminator | 1 | uc |
| 25 | **VECTOR_SOURCE=** | keyword | 14 | 14*uc |
| | quotation mark | - | 1 | uc |
| | Unused - blank | - | 2 | 2*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 26 | spare | - | 41 | 41*uc |

| | | | | |
|---|---|---|---|---|
| 27 | **UTC_SBT_TIME=** | keyword | 13 | 13*uc |
| | quotation mark | - | 1 | uc |
| | UTC time corresponding to SBT below | UTC | 27 | 27*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 28 | **SAT_BINARY_TIME=** | keyword | 16 | 16*uc |
| | Satellite Binary Time (SBT) | - | 11 | Al |
| | newline character | terminator | 1 | uc |
| 29 | **CLOCK STEP=** | keyword | 11 | 11*uc |
| | Clock step in microseconds | microsec. | 11 | Al |
| | <us> | units | 4 | 4*uc |
| | newline character | terminator | 1 | uc |
| 30 | **Spare** | - | 32 | 32*uc |
| | newline character | terminator | 1 | uc |
| 31 | **LEAP_UTC=** | keyword | 9 | 9*uc |
| | quotation mark | - | 1 | uc |
| | UTC time of the occurrence of the Leap Second, not used[6] | UTC | 27 | 27*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 32 | **LEAP_SIGN=** | keyword | 10 | 10*uc |
| | Leap second sign, set to +000 | s | 4 | Ac |
| | newline character | terminator | 1 | 2*uc |
| 33 | **LEAP_ERR=** | keyword | 9 | 9*uc |
| | Leap second error | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 34 | **Spare** | - | 40 | 40*uc |
| | newline character | terminator | 1 | uc |
| 35 | **PRODUCT_ERR=** | keyword | 12 | 12*uc |
| | Not used, set to 0 | - | 1 | 1 |
| | newline character | terminator | 1 | 1 |

[6] Leap seconds are handled internally by the JERS SAR IPF, such that the product georeference is accurate and annotation parameters are self-consistent. Absolute UTC values may be in error by 1 second in the event of data crossing a leap-second boundary.

| | | | | |
|---|---|---|---|---|
| 36 | **TOT_SIZE=** | keyword | 9 | 9*uc |
| | Total Size Of Product | bytes | 21 | Ad |
| | <bytes> | units | 7 | 7*uc |
| | newline character | terminator | 1 | uc |
| 37 | **SPH_SIZE=** | keyword | 9 | 9*uc |
| | Length Of SPH | bytes | 11 | Al |
| | <bytes> | units | 7 | 7*uc |
| | newline character | terminator | 1 | uc |
| 38 | **NUM_DSD=** | keyword | 8 | 8*uc |
| | Number of DSDs | - | 11 | Al |
| | newline character | terminator | 1 | uc |
| 39 | **DSD_SIZE=** | keyword | 9 | 9*uc |
| | Length of Each DSD (# bytes for each DSD, all DSDs have the same length) | - | 11 | Al |
| | <bytes> | units | 7 | 7*uc |
| | newline character | terminator | 1 | uc |
| 40 | **NUM_DATA_SETS=** | keyword | 14 | 14*uc |
| | Number of DSs attached | - | 11 | Al |
| | newline character | terminator | 1 | uc |
| 41 | **Spare** | - | 40 | 40*uc |
| | newline character | terminator | 1 | uc |
| **TOTAL** | | | **1247** | |

### 5.2.2 Specific Product Header (SPH)

**Table 5-4 Specific Product Header (SPH)**

| Field # | Description | Units | Number of bytes | Data Type |
|---|---|---|---|---|
| 1 | **SPH_DESCRIPTOR=** | keyword | 15 | 15*uc |
| | quotation mark | - | 1 | uc |
| | SPH descriptor | - | 28 | 28*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 2 | **STRIPLINE_CONTINUITY_INDICATOR=** | keyword | 31 | 31*uc |
| | Set to 0, no stripline continuity, the product is a complete segment | - | 4 | 4*uc |
| | newline character | terminator | 1 | uc |
| 3 | **SLICE_POSITION=** | keyword | 15 | 15*uc |
| | Set to +001 | - | 4 | 4*uc |
| | newline character | terminator | 1 | uc |
| 4 | **NUM_SLICES=** | keyword | 11 | 11*uc |
| | Set to +001 | - | 4 | 4*uc |
| | newline character | terminator | 1 | uc |
| 5 | **FIRST_LINE_TIME=** | keyword | 16 | 16*uc |
| | quotation mark | - | 1 | uc |
| | First Zero Doppler Azimuth time of product | UTC | 27 | 27*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 6 | **LAST_LINE_TIME=** | keyword | 15 | 15*uc |
| | quotation mark | - | 1 | uc |
| | Last Zero Doppler Azimuth time of product | UTC | 27 | 27*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 7 | **FIRST_NEAR_LAT=** | keyword | 15 | 15*uc |
| | Geodetic Latitude of the first sample of the first line<br>A negative value denotes south Latitude, a positive value denotes North Latitude | (1e-6) degrees | 11 | Al |
| | <10-6degN> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |

| | | | | |
|---|---|---|---|---|
| 8 | **FIRST_NEAR_LONG=** | keyword | 16 | 16*uc |
| | Geodetic Longitude of the first sample of the first line<br>Positive values East of Greenwich, negative values west of Greenwich | (1e-6) degrees | 11 | Al |
| | <10-6degE> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |
| 9 | **FIRST_MID_LAT=** | keyword | 14 | 14*uc |
| | Geodetic Latitude of the middle sample of the first line<br>A negative value denotes south Latitude, a positive value denotes North Latitude | (1e-6) degrees | 11 | Al |
| | <10-6degN> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |
| 10 | **FIRST_MID_LONG=** | keyword | 15 | 15*uc |
| | Geodetic Longitude of the middle sample of the first line<br>Positive values East of Greenwich, negative values west of Greenwich | (1e-6) degrees | 11 | Al |
| | <10-6degE> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |
| 11 | **FIRST_FAR_LAT=** | keyword | 14 | 14*uc |
| | Geodetic Latitude of the last sample of the first line<br>A negative value denotes south Latitude, a positive value denotes North Latitude | (1e-6) degrees | 11 | Al |
| | <10-6degN> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |
| 12 | **FIRST_FAR_LONG=** | keyword | 15 | 15*uc |
| | Geodetic Longitude of the last sample of the first line<br>Positive values East of Greenwich, negative values west of Greenwich | (1e-6) degrees | 11 | Al |
| | <10-6degE> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |
| 13 | **LAST_NEAR_LAT=** | keyword | 14 | 14*uc |
| | Geodetic Latitude of the first sample of the last line<br>A negative value denotes south Latitude, a positive value denotes North Latitude | (1e-6) degrees | 11 | Al |
| | <10-6degN> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |
| 14 | **LAST_NEAR_LONG=** | keyword | 15 | 15*uc |
| | East Geodetic Longitude of the first sample of the last line<br>Positive values East of Greenwich, negative values west of Greenwich | (1e-6) degrees | 11 | Al |
| | <10-6degE> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |

| | | | | |
|---|---|---|---|---|
| 15 | **LAST_MID_LAT=** | keyword | 13 | 13*uc |
| | Geodetic Latitude of the middle sample of the last line<br>A negative value denotes south Latitude, a positive value denotes North Latitude | (1e-6) degrees | 11 | Al |
| | <10-6degN> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |
| 16 | **LAST_MID_LONG=** | keyword | 14 | 14*uc |
| | Geodetic Longitude of the middle sample of the last line<br>Positive values East of Greenwich, negative values west of Greenwich | (1e-6) degrees | 11 | Al |
| | <10-6degE> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |
| 17 | **LAST_FAR_LAT=** | keyword | 13 | 13*uc |
| | Geodetic Latitude of the last sample of the last line<br>A negative value denotes south Latitude, a positive value denotes North Latitude | (1e-6) degrees | 11 | Al |
| | <10-6degN> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |
| 18 | **LAST_FAR_LONG=** | keyword | 14 | 14*uc |
| | Geodetic Longitude of the last sample of the last line<br>Positive values East of Greenwich, negative values west of Greenwich | (1e-6) degrees | 11 | Al |
| | <10-6degE> | units | 10 | 10*uc |
| | newline character | terminator | 1 | uc |
| 19 | **Spare** | - | 35 | 35*uc |
| | newline character | terminator | 1 | uc |
| 20 | **SWATH=** | keyword | 6 | 6*uc |
| | quotation mark | - | 1 | uc |
| | Blank (not used) | - | 3 | 3*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 21 | **PASS=** | keyword | 5 | 5*uc |
| | quotation mark | - | 1 | uc |
| | Ascending or descending orbit designator (ASCENDING or DESCENDING) | - | 10 | 10*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |

| | | | | |
|---|---|---|---|---|
| 22 | **SAMPLE_TYPE=** | keyword | 12 | 12*uc |
| | quotation mark | - | 1 | uc |
| | Detected or complex sample type designator (DETECTED or COMPLEX) | - | 8 | 8*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 23 | **ALGORITHM=** | keyword | 10 | 10*uc |
| | quotation mark | - | 1 | uc |
| | Processing Algorithm Used, set to RAN/DOP (Range / Doppler) | - | 7 | 7*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 24 | **MDS1_TX_RX_POLAR=** | keyword | 17 | 17*uc |
| | quotation mark | - | 1 | uc |
| | Transmitter / Receiver Polarization for MDS 1, set to H/H | - | 3 | 3*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 25 | **MDS2_TX_RX_POLAR=** | keyword | 17 | 17*uc |
| | quotation mark | - | 1 | uc |
| | Blank (not used) | - | 3 | 3*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 26 | **COMPRESSION=** | keyword | 12 | 12*uc |
| | quotation mark | - | 1 | uc |
| | Blank (not used) | - | 5 | 5*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 27 | **AZIMUTH_LOOKS=** | keyword | 14 | 14*uc |
| | Number of Looks in Azimuth | looks | 4 | Ac |
| | newline character | terminator | 1 | uc |
| 28 | **RANGE_LOOKS=** | keyword | 12 | 12*uc |
| | Number of Looks in Range | looks | 4 | Ac |
| | newline character | terminator | 1 | uc |
| 29 | **RANGE_SPACING=** | keyword | 14 | 14*uc |
| | Range sample spacing in meters | m | 15 | Afl |
| | <m> | units | 3 | 3*uc |
| | newline character | terminator | 1 | uc |

| | | | | |
|---|---|---|---|---|
| 30 | **AZIMUTH_SPACING=** | keyword | 16 | 16*uc |
| | Azimuth sample spacing in meters | m | 15 | Afl |
| | <m> | units | 3 | 3*uc |
| | newline character | terminator | 1 | uc |
| 31 | **LINE_TIME_INTERVAL=** | keyword | 19 | 19*uc |
| | Azimuth sample spacing in time (Line Time Interval) | s | 15 | 15 |
| | <s> | units | 3 | 3*uc |
| | newline character | terminator | 1 | uc |
| 32 | **LINE_LENGTH=** | keyword | 12 | 12*uc |
| | Number of samples per output line (includes zero filled samples)<br>If a complex product, 1 sample = 1 I,Q pair,<br>for a detected product, 1 sample = 1 pixel. | samples | 6 | As |
| | <samples> | units | 9 | 9*uc |
| | newline character | terminator | 1 | uc |
| 33 | **DATA_TYPE=** | keyword | 10 | 10*uc |
| | quotation mark | - | 1 | uc |
| | Output data type, SWORD (IMS) or UWORD (other products)<br>The definition of a word here is a 16 bit integer | - | 5 | 5*uc |
| | quotation mark | - | 1 | uc |
| | newline character | terminator | 1 | uc |
| 34 | **Spare** | - | 50 | 50*uc |
| | newline character | terminator | 1 | uc |

| | | | | |
|---|---|---|---|---|
| 35 | **Data Set Descriptors (DSDs)**<br><br>18 data descriptor records, each of 280 bytes in length.<br><br>1 DSD is defined for all possible ADSs and MDSs associated with the product.<br>The DSDs provide addressing linkage for interpretation of the product.<br>For JERS only a few DSDs contain data, with the majority “Not Used”.<br><br>For JERS DSDs are populated for:<br><br>SQ ADSR<br>Main Processing Parameter ADS<br>Doppler Centroid ADS<br>Slant Range to Ground Range Conversion ADS<br>Chirp parameter ADS<br>Antenna Elevation ADS<br>Geolocation Grid ADS (LADS)<br>Map Projection Parameters GADS (for GEC products)<br>Measurement Data Set 1 (MDS) | | 5040 | |
| **TOTAL** | | | **6099** | |

### 5.2.3 Data Set Descriptors (DSDs)

**Table 5-5 Data Set Descriptors (DSDs)**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **DS_NAME=** | keyword | 8 | 8*uc |
| | quotation mark | | 1 | uc |
| | Data Set Name (e.g. MDS1 SQ ADS) | | 28 | 28*uc |
| | quotation mark | | 1 | uc |
| | newline character | | 1 | uc |
| 2 | **DS_TYPE=** | keyword | 8 | 8*uc |
| | **DS Type**<br>= M if a Measurement DS is attached.<br>= A if an Annotation DS is attached<br>= G if a Global ADS is attached<br>= R if no DS is attached (reference DSD only) | | 1 | uc |
| | newline character | terminator | 1 | uc |
| 3 | **FILENAME=** | keyword | 9 | 9*uc |
| | quotation mark | | 1 | uc |
| | Blank (No externally referenced files used) | | 62 | 62*uc |
| | quotation mark | | 1 | uc |
| | newline character | terminator | 1 | uc |
| 4 | **DS_OFFSET=** | keyword | 10 | 10*uc |
| | Total Size of DS in bytes<br>Length in bytes of the Data Set. Set to zero if no DS is attached. | bytes | 21 | Ad |
| | <bytes> | units | 7 | 7*uc |
| | newline character | terminator | 1 | uc |
| 5 | **DS_SIZE=** | keyword | 8 | 8*uc |
| | Total Size of DS in bytes<br>Length in bytes of the Data Set. Set to zero if no DS is attached. | bytes | 21 | Ad |
| | <bytes> | units | 7 | 7*uc |
| | newline character | terminator | 1 | uc |
| 6 | **NUM_DSR=** | keyword | 8 | 8*uc |
| | Number of DSRs within the DS<br>Number of Data Set Records within the DS, set to zero if no DS is attached | | 11 | Al |

| | | | | |
|---|---|---|---|---|
| | newline character | terminator | 1 | uc |
| 7 | **DSR_SIZE=** | keyword | 9 | 9*uc |
| | Length of each DSR if DSR length is constant within the Data Set. | bytes | 11 | Al |
| | <bytes> | units | 7 | 7*uc |
| | newline character | terminator | 1 | uc |
| 8 | **Spare** | ascii | 32 | 32*uc |
| | newline character | terminator | 1 | uc |
| **TOTAL** | | | **280** | |

### 5.2.4 Summary Quality (SQ) ADS

The Summary Quality (SQ) ADS provides a set of quality parameters associated with the raw data and its processing, together with a number of flags which are set if relevant parameters exceed maximum thresholds. A number of these parameters are not used by the JERS SAR IPF.

**Table 5-6 Summary Quality (SQ) ADS**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **Zero Doppler Time at which Summary Quality information applies** | MJD | 12 | mjd |
| 2 | **Attachment Flag (always 0)** | flag | 1 | uc |
| 3 | **Input data mean outside nominal range flag**<br>Not used., set to 0 | flag | 1 | uc |
| 4 | **Input data standard deviation outside nominal range flag**<br>Not used., set to 0 | flag | 1 | uc |
| 5 | **Significant gaps in the input data flag**<br>0 = number of input gaps <= threshold value<br>1 = number of input data gaps > threshold value<br>The threshold is set to 1, i.e. the flag set to 1 if there are *any* data gaps | flag | 1 | uc |
| 6 | **Missing lines significant flag**<br>0 = percentage of missing lines <= threshold value<br>1 = percentage of missing lines > threshold value<br>The number of missing lines is the number of lines missing from the input data | flag | 1 | uc |
| 7 | **Doppler Centroid Uncertain flag**<br>0 = confidence measure[7] >= specified value<br>1 = confidence measure < specified value | flag | 1 | uc |
| 8 | **Doppler ambiguity estimate uncertain flag**<br>Not used, set to 0 | flag | 1 | uc |

[7] "confidence measure" is calculated as the statistic exp(-(mean Doppler tracking error variance)/$10^4$)

| | | | | |
|---|---|---|---|---|
| 9 | **Output data mean outside nominal range flag**<br>0 = mean of I and Q output values for SLC image or mean of detected pixels for a detected product, are both within specified range from expected mean. For expected mean of x, the measured mean must fall between x-threshold to x+threshold<br>1= otherwise | flag | 1 | uc |
| 10 | **Output data standard deviation outside nominal range flag**<br>0 = mean of I and Q output values for SLC image or mean of detected pixels for a detected product, are both within specified range from expected mean. For expected mean of x, the measured mean must fall between x-threshold to x+threshold<br>1 = otherwise | flag | 1 | uc |
| 11 | **Chirp reconstruction failed or is of low quality flag**[8]<br>Not used. Set to 0**.** | flag | 1 | uc |
| 12 | **Data sets missing flag**<br>Not used. Set to 0 | flag | 1 | uc |
| 13 | **Invalid downlink parameters flag**<br>Not used. Set to 0 | flag | 1 | uc |
| 14 | **Spare** | - | 7 | 7*uc |
| 15 | **Threshold for setting the chirp quality flag - Maximum percentagebroadening permitted in cross-correlation pulse width compared to theoretical width.**<br>Not used. Set to 0 | % | 4 | fl |
| 16 | **Threshold for setting the chirp quality flag - First sidelobe of the chirp cross correlation function**<br>Not used. Set to 0 | dB | 4 | fl |
| 17 | **Threshold for setting the chirp quality flag - ISLR of the chirp cross correlation function**<br>Not used. Set to 0 | dB | 4 | fl |
| 18 | **Threshold for setting the mean of input data quality flag**<br>Not used. Set to 0 | - | 4 | fl |
| 19 | **Expected mean input value for this product for both I and Q**<br>Not used. Set to 0 | - | 4 | fl |

[8] JERS SAR did not provide a downlinked chirp, and all pulse compression processing is performed with a synthetic chirp.

| | | | | |
|---|---|---|---|---|
| 20 | **Threshold for setting the standard deviation of input data quality flag**<br>Not used. Set to 0 | - | 4 | fl |
| 21 | **Expected input std. dev. for this product for both I and Q**<br>Not used. Set to 0 | - | 4 | fl |
| 22 | **Threshold for setting the Doppler Centroid quality flag - Threshold for Doppler Centroid confidence** | - | 4 | fl |
| 23 | **Threshold for setting the Doppler Centroid ambiguity quality flag**<br>Not used. Set to 0 | - | 4 | fl |
| 24 | **Threshold for setting the mean of output data quality flag**<br>For an expected mean value of x, this is the value T, such that the measured mean must fall between the x-T and x+T | - | 4 | fl |
| 25 | **Expected mean output value for this product.**<br>For an SLC product this is the expected mean of both the I and Q values | - | 4 | fl |
| 26 | **Threshold for setting the standard deviation of output data quality flag**<br>For an expected standard deviation value of y, this is the value D, such that the measured standard deviation must fall between the y-D and y+D | - | 4 | fl |
| 27 | **Expected output standard deviation for this product**<br>For an SLC product this is the expected output std. dev. for both I and Q values. | - | 4 | fl |
| 28 | **Threshold for setting the missing lines quality flag**<br>Maximum percentage of missing lines to total lines allowed | % | 4 | fl |
| 29 | **Threshold for setting the missing gaps quality flag**<br>Maximum number of missing gaps allowed. Set to 1 | - | 4 | fl |
| 30 | **Number of missing lines which constitute a gap**<br>Set to 1 | lines | 4 | fl |
| 31 | **Spare** | - | 15 | 15*uc |

| | | | | |
|---|---|---|---|---|
| 32 | **Input data mean**<br>I channel, Q channel | - | 2*4 | 2* fl |
| 33 | **Input data standard deviation**<br>I channel, Q channel | - | 2*4 | 2* fl |
| 34 | **Number of gaps**<br>Composed of a predetermined number of consecutive missing lines | - | 4 | fl |
| 35 | **Number of missing lines** | - | 4 | fl |
| 36 | **Output data mean**<br>For SLC products, first value is for the I channel, second is for the Q channel.<br>For detected products, the second value is set to 0. | - | 2*4 | 2* fl |
| 37 | **Output data standard deviation**<br>For SLC products, first value is for the I channel, second is for the Q channel<br>For detected products, second value is set to 0 | - | 2*4 | 2* fl |
| 38 | **Total number of errors detected in ISP headers**<br>Not used, set to 0 | - | 4 | fl |
| 39 | **Spare** | - | 16 | 16*uc |
| **TOTAL** | | | **170** | |

### 5.2.5 Main Processing Parameters ADS

The MPP ADS collate all the high-level parameters used to generate the product.

**Table 5-7 Main Processing Parameters ADS**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **First Zero Doppler Azimuth time of MDS** | MJD | 12 | mjd |
| 2 | **Attachment Flag (always set to 0 for this ADS)** | flag | 1 | uc |
| 3 | **Last Zero Doppler Azimuth time of MDS** | MJD | 12 | mjd |
| 4 | **Work Order ID** | - | 12 | 12*uc |
| 5 | **Time difference between sensing time of first input line and zero Doppler time of first output image line** | s | 4 | fl |
| 6 | **Swath number**<br>Not used | - | 3 | 3*uc |
| 7 | **Range sample spacing** | m | 4 | fl |
| 8 | **Azimuth sample spacing at image center** | m | 4 | fl |
| 9 | **Azimuth sample spacing in time** | s | 4 | fl |
| 10 | **Number of output range lines in the image** | lines | 4 | ul |
| 11 | **Number of samples per output range line** | samples | 4 | ul |
| 12 | **Output data type**<br>SWORD or UWORD | - | 5 | 5*uc |
| 13 | **Number of output range lines per burst**<br>Not used | lines | 4 | 4*uc |
| 14 | **Time difference between zero Doppler time and acquisition time of output image lines** | s | 4 | fl |
| 15 | **Spare** | - | 43 | 43*uc |

| | | | | |
|---|---|---|---|---|
| 16 | **Raw Data Analysis used for Raw Data Correction**[9]<br>Set to 0 | flag | 1 | uc |
| 17 | **Antenna Elevation Pattern Correction Applied**<br>0 = no correction applied<br>1 = correction applied<br>Always 1 | flag | 1 | uc |
| 18 | **Reconstructed Chirp to be used**<br>Set to 0 (Not Used - no downlink chirp for JERS SAR) | flag | 1 | uc |
| 19 | **Slant Range to Ground Range Conversion Applied**<br>0 = no conversion applied<br>1 = conversion applied | flag | 1 | uc |
| 20 | **Doppler Centroid Estimation Performed**<br>0 = no estimation done<br>1 = estimation done<br>Always set to 1 | flag | 1 | uc |
| 21 | **Doppler Ambiguity Estimation Performed**<br>Set to 0, Not Used | flag | 1 | uc |
| 22 | **Range Spreading loss compensation Applied**<br>0 = no compensation applied<br>1 = compensation applied<br>Always set to 1 | flag | 1 | uc |
| 23 | **Detection Applied**<br>0 = output product is complex<br>1 = output product was detected | flag | 1 | uc |
| 24 | **Look Summation Performed**<br>0 = product is single look<br>1 = product is multi-looked | flag | 1 | uc |
| 25 | **RMS Equalisation performed**<br>Set to 0, Not Used | flag | 1 | uc |

[9] Raw data DC bias (and other CW noise) is eliminated by notch filtering during processing and not through explicit use of raw data statistics.

| | | | | |
|---|---|---|---|---|
| 26 | **Antenna Elevation Gain Scaling Factor**<br>0= no scaling factor applied<br>1 = scaling factor applied<br>Always set to 1 | flag | 1 | uc |
| 27 | **Receive Gain Droop Compensation Applied to Echo Data**<br>Set to 1 (STC compensation always applied) | flag | 1 | uc |
| 28 | **Receive Gain Droop Compensation Applied to Calibration Pulse P2**<br>Not used | flag | 1 | 1 |
| 29 | **Receive Gain Droop Compensation for Calibration Pulse P2 Order Zero: Nominal Time Delay Applied**<br>Not used | flag | 1 | uc |
| 30 | **Inverse Filter used for range compression**<br>Not used | flag | 1 | uc |
| 31 | **Spare** | - | 6 | 6*uc |
| 32 | **Raw Data Analysis**<br>The following 26 parameters form a structure that is repeated twice, once for MDS1 and once for MDS2<br>None of these parameters are used for JERS SAR products | | | |
| | **Number of input data gaps** | | | |
| | **Number of missing lines, excluding data gaps** | lines | 4 | ul |
| | **Range sample skipping factor for raw data analysis** | samples | 4 | ul |
| | **Range lines skipping factor for raw data analysis** | lines | 4 | ul |
| | **Calculated I channel bias** | | 4 | 4*fl |
| | **Calculated Q channel bias** | | 4 | 4*fl |
| | **Calculated I channel standard deviation** | | 4 | 4*fl |
| | **Calculated Q channel standard deviation** | | 4 | 4*fl |
| | **Calculated I/Q gain imbalance** | | 4 | 4*fl |
| | **Calculated I/Q quadrature departure** | | 4 | 4*fl |

| | | | | |
|---|---|---|---|---|
| | **I bias upper bound** | | 4 | 4*fl |
| | **I bias lower bound** | | 4 | 4*fl |
| | **Q bias upper bound** | | 4 | 4*fl |
| | **Q bias lower bound** | | 4 | 4*fl |
| | **I/Q gain lower bound** | | 4 | 4*fl |
| | **I/Q gain upper bound** | | 4 | 4*fl |
| | **I/Q quadrature departure lower bound** | | 4 | 4*fl |
| | **I/Q quadrature departure upper bound** | | 4 | 4*fl |
| | **I bias significance** | | 1 | uc |
| | **Q bias Significance** | | 1 | uc |
| | **I/Q Gain Significance** | | 1 | uc |
| | **I/Q Quadrature Departure Significance** | | 1 | uc |
| | **I channel bias used for correction** | | 4 | 4*fl |
| | **Q channel bias used for correction** | | 4 | 4*fl |
| | **I/Q gain imbalance used for correction** | | 4 | 4*fl |
| | **I/Q quadrature departure used for correction** | | 4 | 4*fl |
| 33 | **Spare** | - | 32 | 32*uc |
| 34 | **Start Time Values**<br>The following 2 parameters form a structure that is repeated twice, once for MDS1 and once for MDS2<br>Neither of these parameters are used for JERS SAR products | | | |
| | **On-board time of first input line processed** | | 8 | 2*ul |
| | **Sensing time (MJD format) of first input line processed converted from satellite binary time** | MJD | 12 | mjd |

| | | | | |
|---|---|---|---|---|
| 35 | **Parameter Codes**<br>Each of the following is an array with 5 elements (corresponding to ASAR beams)<br>None of the parameters are used for JERS SAR products | | | |
| | **Sampling Window Start time code of first processed line** | | 10 | 5*us |
| | **Sampling Window Start time code of last processed line** | | 10 | 5*us |
| | **Pulse Repetition Interval code** | | 10 | 5*us |
| | **Tx pulse length** | | 10 | 5*us |
| | **Tx pulse bandwidth** | | 10 | 5*us |
| | **Echo Window Length** | | 10 | 5*us |
| | **Upconverter Level** | | 10 | 5*us |
| | **Downconverter Level** | | 10 | 5*us |
| | **Resampling factor for echo data** | | 10 | 5*us |
| | **Beam adjustment delta** | | 10 | 5*us |
| | **Antenna Beam Set Number** | | 10 | 5*us |
| | **Auxiliary Tx Monitor Level** | | 10 | 5*us |
| 36 | **Spare** | - | 60 | 60*uc |
| 37 | **Error Counters**<br>The following 12 error counters are not used for JERS SAR products. | | | |
| | **Number of errors detected in Sampling Window start time field** | | 4 | ul |
| | **Number of errors detected in PRI code field** | | 4 | ul |
| | **Number of errors detected in Tx pulse length field** | | 4 | ul |
| | **Number of errors detected in Tx pulse bandwidth field** | | 4 | ul |
| | **Number of errors detected in Echo Window Length field** | | 4 | ul |
| | **Number of errors detected in Calibration Subsystem Attenuation Select field** | | 4 | ul |

| | | | | |
|---|---|---|---|---|
| | **Number of errors detected in Upconverter Level field** | | 4 | ul |
| | **Number of errors detected in Downconverter Level field** | | 4 | ul |
| | **Number of errors detected in RF Subsystem Gain Select** | | 4 | ul |
| | **Number of errors detected in Resampling factor for echo data field** | | 4 | ul |
| | **Number of errors detected in Beam adjustment delta field** | | 4 | ul |
| | **Number of errors detected in Antenna Beam Set Numberfield.** | | 4 | ul |
| 38 | **Spare** | - | 26 | 26*uc |
| 39 | **Image Data Set Parameters**<br>Each field has 5 values, the last 4 of which are set to zero | | | |
| | **Sampling Window Start time of first processed line** | s | 5*4 | fl |
| | **Sampling Window Start time of last processed line** | s | 5*4 | fl |
| | **Number of Sample Window Start Time changes** | - | 5*4 | ul |
| | **Pulse Repetition Frequency** | Hz | 5*4 | fl |
| | **Tx pulse length** | s | 5*4 | fl |
| | **Tx pulse bandwidth** | Hz | 5*4 | fl |
| | **Echo window length** | s | 5*4 | fl |
| | **Upconverter Level** (Not used) | dB | 5*4 | fl |
| | **Downconverter Level** (Not used) | dB | 5*4 | fl |
| | **Resampling factor** (Not used) | - | 5*4 | fl |
| | **Beam adjustment delta** (Not used) | deg. | 5*4 | fl |
| | **Antenna Beam Set Number** (Not used) | - | 5*2 | us |
| | **Auxiliary Tx Monitor Level** (Not used) | - | 5*4 | fl |
| | **Rank** (Not used) | - | 5*4 | ul |
| 40 | **Spare** | - | 62 | 62*uc |

| | | | | |
|---|---|---|---|---|
| 41 | **First processed input range sample** | samples | 4 | fl |
| 42 | **Range spreading loss reference range** | m | 4 | fl |
| 43 | **Range sampling rate** | Hz | 4 | fl |
| 44 | **Radar Frequency** | Hz | 4 | fl |
| 45 | **Number of range looks** | looks | 2 | us |
| 46 | **Matched filter window type**<br>(HANNING or NONE) | - | 7 | 7*uc |
| 47 | **Window coefficient for range window filter** | - | 4 | fl |
| 48 | **Range Bandwidth**<br>Each of the following is an array with 5 elements (corresponding to ASAR beams)<br>Only the first elements are populated for JERS SAR products. Unused values are set to zero | | | |
| | **Range Look bandwidth (null to null)** | Hz | 20 | 5*fl |
| | **Total processed range bandwidth (null to null)** | Hz | 20 | 5*fl |
| 49 | **Nominal Chirp**<br>The following 2 parameters form a structure which is repeated 5 times. Only the first structure is populated | | | |
| | **4 nominal chirp amplitude coefficients**<br>1.0,<br>0.0,<br>0.0,<br>0.0 | -, $s^{-1}$, $s^{-2}$, $s^{-3}$ | 4*4 | 4*fl |
| | **4 nominal chirp phase coefficients**<br>0.0,<br>0.0,<br>4.2757004E+11<br>0.0 | cycles,Hz,Hz/s,$Hz/s^2$ | 4*4 | 4*fl |
| 50 | **Spare** | | 60 | 60*uc |
| 51 | **Number of input lines processed** | lines | 4 | ul |

| | | | | |
|---|---|---|---|---|
| 52 | **Number of Azimuth Looks** | looks | 2 | us |
| 53 | **Azimuth Look Bandwidth (null to null)** | Hz | 4 | fl |
| 54 | **Processed Azimuth bandwidth(null to null)** | Hz | 4 | fl |
| 55 | **Matched filter window type**<br>(HANNING or NONE) | | 7 | 7*uc |
| 56 | **Window coefficient for azimuth-matched filter** | | 4 | fl |
| 57 | **3 coefficients for Azimuth FM rate**<br>Azimuth FM rate =<br>C0 + C1(tSR-t0) + C2(tSR - t0)2<br>where tSR = 2 way slant range time | Hz/sHz/$s^2$Hz/$s^3$ | 3*4 | 3*fl |
| 58 | **2 way slant range time origin (t0) for Azimuth FM rate calculation** | ns | 4 | fl |
| 59 | **Doppler Centroid Ambiguity Confidence Measure**<br>Value between 0 and 1, 0 = poorest confidence, 1= highest confidence<br>Not used. Set to 0. | - | 4 | fl |
| 60 | **Spare** | - | 68 | 68*uc |
| 61 | **Calibration Factors**<br>The following 2 parameters form a structure which is repeated twice. Fields in the second group are set to zero | | | |
| | **Processor scaling factor** | | 4 | fl |
| | **External Calibration Scaling Factor** | | 4 | fl |

| | | | | |
|---|---|---|---|---|
| 62 | **Noise Estimation**<br>Each of the following is an array with 5 elements (corresponding to ASAR beams)<br>Not used for JERS SAR products | | | |
| | **Noise power correction factor** | | 20 | 5*fl |
| | **Number of noise lines used to calculate correction factors** | | 20 | 5*fl |
| 63 | **Spare** | | 64 | 64*uc |
| 64 | **Spare** | | 12 | 12*uc |
| 65 | **Output Data Statistics**<br>The following 4 parameters form a structure which is repeated twice. The fields in the second group are set to zero | | | |
| | **Output data mean**<br>Magnitude for detected products, real sample mean for SLC products | - | fl | 4 |
| | **Output imaginary data mean**<br>Used for SLC products only (set to 0 otherwise) | - | fl | 4 |
| | **Output data standard deviation**<br>Magnitude std. dev. for detected products, real sample std. dev. for SLC products | - | fl | 4 |
| | **Output imaginary data standard deviation**<br>Used for SLC products only (set to 0 otherwise) | - | fl | 4 |
| 66 | **Average scene height above ellipsoid used for processing**<br>Not used | m | 4 | fl |
| 67 | **Spare** | | 48 | 48*uc |
| 68 | **Compression Method used for echo samples**<br>Not used | | 4 | 4*uc |
| 69 | **Compression Ratio for echo samples**<br>Not used | | 3 | 3*uc |

| | | | | |
|---|---|---|---|---|
| 70 | **Compression Method used for initial calibration samples** Not used | | 4 | 4*uc |
| 71 | **Compression Ratio for initial calibration samples** Not used | | 3 | 3*uc |
| 72 | **Compression Method used for periodic calibration samples** Not used | | 4 | 4*uc |
| 73 | **Compression Ratio for periodic calibration samples** Not used | | 3 | 3*uc |
| 74 | **Compression Method used for noise samples** Not used | | 4 | 4*uc |
| 75 | **Compression Ratio for noise samples** Not used | | 3 | 3*uc |
| 76 | **Spare** | | 64 | 64*uc |
| 77 | **Number of slant range samples in beam merging, one value per merge region** Not used | | 16 | 4*ul |
| 78 | **Beam merge algorithm parameter used for beam merging, one value per merge region.** Not used | | 16 | 4*fl |
| 79 | **Number of lines per burst for this image** Not used | | 20 | 5*ul |
| 80 | **Time of first SS1 Echo Source Packet** Not used | MJD | 12 | mjd |
| 81 | **Spare** | | 28 | 28*uc |

| | | | | |
|---|---|---|---|---|
| 82 | **Orbit State Vectors Information**<br>The following 7 parameters form a structure which is repeated 5 times, to provide 5 orbit state vectors which span the scene | | | |
| | **Time of state vector** | MJD | 12 | mjd |
| | **X position in Earth fixed reference frame** | $10^{-2}$m | 4 | sl |
| | **Y position in Earth fixed reference frame** | $10^{-2}$m | 4 | sl |
| | **Z position in Earth fixed reference frame** | $10^{-2}$m | 4 | sl |
| | **X velocity relative to Earth fixed reference frame** | $10^{-5}$m/s | 4 | sl |
| | **Y velocity relative to Earth fixed reference frame** | $10^{-5}$m/s | 4 | sl |
| | **Z velocity relative to Earth fixed reference frame** | $10^{-5}$m/s | 4 | sl |
| 83 | **Spare** | | 64 | 64*uc |
| **TOTAL** | | | **2009** | |

### 5.2.6 Doppler Centroid Coefficients ADS

The information in the Doppler Centroid Coefficients ADS is derived from a Doppler tracking analysis undertaken over a series of unfocussed data patches spanning the raw data for the scene. Patches are of dimensions 256 samples by 8192 echoes, with typically 12 patches in range and 8 in azimuth for a standard scene. The Doppler coefficients in each ADS record are derived from a weighted bicubic fit of the resulting frequency data as a function of range and zero-Doppler time.

**Table 5-8 Doppler Centroid Coefficients ADS**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **Zero Doppler azimuth time at which estimate applies** | MJD | 12 | mjd |
| 2 | **Attachment Flag**<br>Set to 0 | flag | 1 | uc |
| 3 | **2-way slant range time origin** (t0) | ns | 4 | fl |
| 4 | **Doppler coefficients**<br>Doppler centroid coefficients as a function of slant range time: D0, D1, D2, D3, and D4. Where:<br>Doppler Centroid = D0 + D1(tSR-t0) + D2(tSR-t0)$^2$ + D3(tSR-t0)$^3$ + D4(tSR-t0)$^4$<br>D4 is zero. | HzHz/sHz/s$^2$Hz/s$^3$Hz/s$^4$ | 5*4 | 5*fl |
| 5 | **Doppler Centroid Confidence Measure**.<br>Value between 0 and 1, 0 = poorest confidence, 1= highest confidence | - | 4 | fl |
| 6 | **Doppler Centroid Confidence below threshold flag**<br>0=confidence above threshold, centroid calculated from data<br>1=confidence below threshold, centroid calculated from orbit parameters | flag | 1 | uc |
| 7 | **Delta Doppler coefficients**<br>Not used | - | 5*2 | 10*uc |
| 8 | **Spare** | - | 3 | 3*uc |
| **TOTAL** | | | **55** | |

### 5.2.7 Slant Range to Ground Range (SG/GR) Conversion ADS

The SR/GR ADS defines the relationship between image range and slant range. The SR/GR ADSR provide a sequence of records along the azimuth extent of the product, with a new record generated every 12 seconds along track. The JERS SAR IPF ground range image products have a fixed relationship between slant and "ground" range, with nominal parameters evaluated at the image centre; the image range/slant range relationship does not evolve with the product, and as a consequence all SR/GR ADSRs are identical. The sequence of SR/GR ADSRs supplied is solely for compatibility reasons; each SR/GR ADSR is supplied at the same epoch as other ADSR updated along the track of the image.

**Table 5-9 SG/GR Conversion ADS**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **Zero Doppler Time in azimuth from which parameters apply** | MJD | 12 | mjd |
| 2 | **Attachment Flag**<br>Set to 0 | flag | 1 | uc |
| 3 | **2 way slant range-time to first range sample** | ns | 4 | fl |
| 4 | **Ground range origin of the polynomial (GR0)** | m | 4 | fl |
| 5 | **The coefficients S0, S1, S2, S3, and S4 of the ground range to slant range conversion polynomial.**<br>Slant range = $S0 + S1(GR-GR0) + S2 (GR-GR0)^2 + S3(GR-GR0)^3 + S4(GR-GR0)^4$<br>where GR is the ground range distance from the first pixel of the range line. | m, -, m-1, m-2 | 5*4 | 5*fl |
| 6 | **Spare** | - | 14 | 14*uc |
| **TOTAL** | | | **55** | |

### 5.2.8 Chirp Parameters ADS

The JERS SAR did not provide a downlinked chirp. The parameters used by the JERS SAR IPF for pulse compression are based on nominal values, optimised to achieve the best focus in range. The chirp applied in the video frequency domain has a unit amplitude. The Chirp ADSRs are generated solely to provide structural compatibility with pre-existing software; they provide zero information.

**Table 5-10 Chirp Parameters ADS**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **Zero Doppler Time in azimuth from which parameters apply** | MJD | 12 | mjd |
| 2 | **Attachment flag**<br>Set to 0 | flag | 1 | uc |
| 3 | **Beam ID**<br>Not used | - | 3 | 3*uc |
| 4 | **Polarisation** Set to H/H | - | 3 | 3*uc |
| 5 | **3-dB pulse width of chirp replica cross-correlation function between reconstructed chirp and nominal chirp** | samples | 4 | fl |
| 6 | **First side lobe level of chirp replica cross-correlation function between reconstructed chirp and nominal chirp**<br>Set to -13.2 | dB | 4 | fl |
| 7 | **ISLR of chirp replica cross-correlation function between reconstructed chirp and nominal chirp**<br>Not used | dB | 4 | fl |
| 8 | **Peak location of cross-correlation function between reconstructed chirp and nominal chirp** Set to 0 | samples | 4 | fl |
| 9 | **Reconstructed chirp power** Set to 0 | dB | 4 | fl |

| | | | | |
|---|---|---|---|---|
| 10 | **Equivalent chirp power**<br>Not used | dB | 4 | fl |
| 11 | **Reconstructed chirp exceeds quality thresholds**<br>Not used | flag | 1 | uc |
| 12 | **Reference chirp power** Set to 0 | dB | 4 | fl |
| 13 | **Normalization source**<br>Not used | - | 7 | 7*uc |
| 14 | **Spare** | - | 4 | 4*uc |
| 15 | **Calibration Pulses**<br>The following 4 parameters form a structure which is repeated 32 times (once for each row)<br>Each repetition consists of a total of 11 measurements of 4 different types as described below<br>None of these values are used for JERS SAR products | | | |
| | **Max of Cal pulses 1, 2, and 3 amplitude** | | 12 | 3*fl |
| | **Average of Cal pulse 1, 2, and 3 amplitude over the 3 dB on either side of the max amplitude** | | 12 | 3*fl |
| | **Average of Cal pulse 1A over the sample window** | | 4 | fl |
| | **Extracted phase for calibration pulse 1, 1A, 2, and 3** | | 16 | 4*fl |
| 16 | **Spare** | - | 16 | 16*uc |
| **TOTAL** | | | **1483** | |

### 5.2.9 Antenna Elevation Pattern ADS

The Antenna Elevation Pattern ADS characterises the range antenna gain pattern as a function of slant range time. In principle this changes (very slowly) as a function of changing platform altitude with latitude. The JERS SAR IPF currently adopts a fixed characterisation corresponding to image centre. Multiple, time-dependent, ADSRs are generated solely to provide compatibility with pre-existing software. All JERS SAR image products are compensated for the antenna elevation pattern

**Table 5-11 Antenna Elevation Pattern ADS**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **Zero Doppler azimuth time at which pattern applies** | MJD | 12 | mjd |
| 2 | **Attachment flag**<br>Set to 0 | flag | 1 | uc |
| 3 | **Beam ID to which pattern applies**<br>Not Used | - | 3 | 3*uc |
| 4 | **Antenna Elevation Pattern**<br>The following fields each contain 11 values spaced evenly across the image in range | | | |
| | **2 way slant range times** | ns | 11*4 | 11*fl |
| | **Corresponding elevation angles** | degrees | 11*4 | 11*fl |
| | **Corresponding two-way antenna elevation pattern values** | dB | 11*4 | 11*fl |
| 5 | **Spare** | | 14 | 14*uc |
| **TOTAL** | | | **162** | |

### 5.2.10 Geolocation Grid ADS (or LADS)

The Geolocation Grid ADS (or LADS) provides a detailed set of tie-points covering the image in range and along track; at each tie-point the geodetic Latitude and Longitude are provided to facilitate external georeferencing of the product.

**Table 5-12 Geolocation Grid ADS (or LADS)**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **Zero Doppler time in azimuth of first line of the granule** | MJD | 12 | mjd |
| 2 | **Attachment flag**<br>Set to 0 | flag | 1 | uc |
| 3 | **Range line number corresponding to the first line of the granule within the slice** | - | 4 | ul |
| 4 | **Number of output lines in this granule** | lines | 4 | ul |
| 5 | **Subsatellite track heading (relative to North) for first line of granule** | deg. | 4 | fl |
| 6 | **First Line Tie Points**<br>The following fields each contain 11 values corresponding to 11 tie points in the first line of the granule | | | |
| | **2 way slant range time to range sample** | ns | 11*4 | 11*fl |
| | **Incidence Angle at range sample** | deg. | 11*4 | 11*fl |
| | **Geodetic latitude (positive north)** | deg*$10^{-6}$ | 11*4 | 11*sl |
| | **Geodetic longitude (positive east)** | deg*$10^{-6}$ | 11*4 | 11*sl |
| 7 | **Spare** | | 22 | 22*uc |
| 8 | **Zero Doppler time for the last line of the granule** | MJD | 12 | Mjd |

| | | | | |
|---|---|---|---|---|
| 9 | **Last Line Tie Points**<br>The following fields each contain 11 values corresponding to 11 tie points in the last line of the granule | | | |
| | **2 way slant range time to range sample** | ns | 11*4 | 11*fl |
| | **Incidence Angle at range sample** | deg. | 11*4 | 11*fl |
| | **Geodetic latitude (positive north)** | deg*$10^{-6}$ | 11*4 | 11*sl |
| | **Geodetic longitude (positive east)** | deg*$10^{-6}$ | 11*4 | 11*sl |
| 10 | **Spare** | | 22 | 22*uc |
| **TOTAL** | | | **521** | |

### 5.2.11 Map Projection Parameters GADS

The map GADS are only provided with products generated in a geographical projection. The ADS reserves space for parameters associated with UTM, UPS or other projections (not currently supported); only data for the specified projection is relevant.

**Table 5-13 Map Projection Parameters GADS**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **Map Projection descriptor**<br>UNIVERSAL_POLAR_STEREOGRAPHIC or<br>UNIVERSAL_TRANSVERSE_MERCATOR | - | 32 | AsciiString |
| 2 | **Number of samples per line** | - | 4 | ul |
| 3 | **Number of lines** | - | 4 | ul |
| 4 | **Nominal inter-sample distance** | m | 4 | fl |
| 5 | **Nominal inter-line distance** | m | 4 | fl |
| 6 | **Output scene centre orientation** | deg | 4 | fl |
| 7 | **Spare** | - | 40 | 40*uc |
| 8 | **Heading**<br>Platform heading | deg | 4 | fl |
| 9 | **Reference ellipsoid name** | - | 32 | 32*uc |
| 10 | **Ellipsoid semi-major axis**, metres<br>Set to 6378137.0 | m | 4 | fl |
| 11 | **Ellipsoid semi-minor axis**, metres<br>Set to 6356752.5 | m | 4 | fl |
| 12 | **Datum shift parameter referenced to Greenwich: dx (metres)** | m | 4 | fl |
| 13 | **Datum shift parameter referenced to Greenwich: dy (metres)** | m | 4 | fl |

| | | | | |
|---|---|---|---|---|
| 14 | **Datum shift parameter referenced to Greenwich: dz (metres)** | m | 4 | fl |
| 15 | **Average heigh over ellipsoid used for geocoding** | - | 4 | fl |
| 16 | **Spare** | - | 12 | 12*uc |
| 17 | **Map Projection alphanumeric description** | - | 32 | 32*uc |
| 18 | **UTM descriptor Set to** UNIVERSAL_TRANSVERSE_MERCATOR | - | 32 | 32*uc |
| 19 | **UTM zone signature** | - | 4 | 4*uc |
| 20 | **Map origin, false easting** | m | 4 | fl |
| 21 | **Map origin, false northing** | m | 4 | fl |
| 22 | **Projection centre Longitude, deg** | (1e-6) degrees | 4 | sl |
| 23 | **Projection centre Latitude, deg** | (1e-6) degrees | 4 | sl |
| 24 | **1st standard parallel, deg** | deg | 4 | fl |
| 25 | **2nd standard parallel, deg** | deg | 4 | fl |
| 26 | **Scale factor** | - | 4 | fl |
| **27** | **UPS descriptor Set to** UNIVERSAL_POLAR_STEREOGRAPHIC | - | 32 | 32*uc |
| 28 | **Projection centre Longitude, deg** | (1e-6) degrees | 4 | sl |
| 29 | **Projection centre Latitude, deg** | (1e-6) degrees | 4 | sl |
| 30 | **Scale factor** | - | 4 | fl |
| **National Projection data fields**<br>Not used | | | | |
| 31 | **NSP descriptor** | | 32 | 32*uc |
| 32 | **Map origin, false easting** | m | 4 | fl |
| 33 | **Map origin, false northing** | m | 4 | fl |
| 34 | **Projection centre longitude** | deg*$10^{-6}$ | 4 | sl |
| 35 | **Projection centre latitude** | deg*$10^{-6}$ | 4 | sl |

| | | | | |
|---|---|---|---|---|
| 36 | **Standard parallels parameters** | | | |
| | **Standard parallel 1** (for Lambert Conformal conic projection only otherwise 0) | deg | 4 | fl |
| | **Standard parallel 2** (for Lambert Conformal conic projection only otherwise 0) | deg | 4 | fl |
| | **Spare** | | 8 | 8*uc |
| 37 | **Central Meridian parameters** | | | |
| | **Central meridian** Longitude of the central meridian or Longitude down below pole of map for Polar Sterographic | deg | 4 | fl |
| | **Spare** | | 8 | 8*uc |
| 38 | **Projection dependent parameters** | | | |
| | **Scale factor at central meridian** (for Transverse Mercator Projection,otherwise 0) | | 4 | fl |
| | **Spare** | | 12 | 12*uc |

| | | | | |
|---|---|---|---|---|
| 39 | **Positioning Information in Northings and Eastings** | | | |
| | **Top left corner northing, meters;** | m | 4 | fl |
| | **Top left corner easting, meters;** | m | 4 | fl |
| | **Top right corner northing, meters;** | m | 4 | fl |
| | **Top right corner easting, meters;** | m | 4 | fl |
| | **Bottom right corner northing, meters;** | m | 4 | fl |
| | **Bottom right corner easting, meters;** | m | 4 | fl |
| | **Bottom left corner northing, meters;** | m | 4 | fl |

| | | | | |
|---|---|---|---|---|
| | **Bottom left corner easting, meters;** | m | 4 | fl |
| 40 | **Positioning Information in Latitude and Longitude** | | | |
| | **Top left corner Latitude** | (1e-6) degrees | 4 | sl |
| | **Top left corner Longitude** | (1e-6) degrees | 4 | sl |
| | **Top right corner Latitude** | (1e-6) degrees | 4 | sl |
| | **Top right corner Longitude** | (1e-6) degrees | 4 | sl |
| | **Bottom right corner Latitude** | (1e-6) degrees | 4 | sl |
| | **Bottom right corner Longitude** | (1e-6) degrees | 4 | sl |
| | **Bottom left corner Latitude** | (1e-6) degrees | 4 | sl |
| | **Bottom left corner Longitude** | (1e-6) degrees | 4 | sl |
| 41 | **Spare** | - | 32 | 32*uc |
| 42 | **Coefficients for image to map conversion**<br>8 coefficients to convert a line(L) and sample (S) position to the map projection frame of reference, say (E,N)E = A11 + A12*L + A13 *S + A14 *L*SN = A21 + A22*L + A23 *S + A24 *L*S | - | 8*4 | fl |
| 43 | **Coefficients for map to image conversion**<br>8 coefficients to convert from the map projection (E,N) to line (L) and sample(S) position in the imageL = B11 + B12*E + B13 *N + B14 *E*NS = B21 + B22*E + B23 *N + B24 *E*N | - | 8*4 | fl |
| 44 | **Spare** | - | 35 | 35*uc |
| **TOTAL** | | | **591** | |

### 5.2.12 Measurement Data Set

The MDS is the image data product itself, and consists of a sequence of records spanning the product. The header time stamp is only valid for data provided in SAR zero-Doppler coordinates (the time stamp is null for geocoded products). For data in SAR coordinates, data is output in increasing range, from the earliest image line to the last image line. For geocoded products, each record contains samples from East to West, with successive records decreasing in latitude (for UPS, from left to right, and top to bottom). Pixels are 16 bit integer values; for complex images, I and Q channels are interleaved as pairs of signed 16 bit values, I then Q.

**Table 5-14 Measurement Data Set (MDS)**

| Field # | Description | Units | Number of Bytes | Data Type |
|---|---|---|---|---|
| 1 | **Zero Doppler time in azimuth**<br>MJD format | MJD | 12 | mjd |
| 2 | **Quality Indicator** | flag | 1 | uc |
| 3 | **Line number** | - | 4 | ul |
| 4 | **SAR Processed Data**. | - | 2 | ul |
| **TOTAL** | | | **variable** | |

# 6 Product File Structure for GEOTIFF/TIFF format

## 6.1 Introduction

TIFF is a ubiquitous and well understood format in routine use worldwide for transfer of image data, and this document will not attempt to duplicate TIFF specifications available via e.g. [RD-3] and elsewhere.

GEOTIFF extends the capabilities of TIFF; a TIFF tag (code 34735) is reserved to define a GEOKEY directory; the GEOKEY directory and GEOTIFF architecture retains the overall TIFF concept, but at a further level of indirection.

GEOTIFF-enabled TIFF readers interpret the GEOKEY directory information; simple TIFF readers simply ignore TIFF tags such as the GEOKEY directory tag, that they are not equipped to interpret. As a consequence GEOTIFF products can be handled as TIFF products, but retaining a capability for correctly georeferencing projected image data.

## 6.2 JERS SAR Level 1 GEOTIFF/TIFF products

With the exception of the single look complex product (JSA_IMS_1P) all product types may be obtained in GEOTIFF/TIFF format (see Table 3-1 JERS/SEASAT SAR Level 1 products available in ENVISAT/GEOTIFF/TIFF format). Any geocoded product will be generated with the GEOTIFF extensions; products in SAR coordinates will be generated as simple TIFFs. The GEOTIFF products are denoted by a ".GTIF" suffix; simple TIFF products by a ".TIFF" suffix.

Quicklooks are generated with every product, including JSA_IMS_1P (see section 3.3); the quicklooks are all provided as North-oriented PNG formatted images.

JERS TIFFs/GEOTIFFs may be obtained as either 1 or 2 byte/sample products. It should be noted however that 1-byte TIFF products are radiometrically *uncalibrated*. In view of their limited dynamic range 1-byte TIFF image data is appropriately scaled to provide good contrast and minimal saturation. Image data pixels in the 2 byte TIFF/GEOTIFF products however have identical values to the pixels in a corresponding ENVISAT formatted MDS.

All GEOTIFF/TIFF products are provided in "little-endian" format[10], with byte ordering from least significant to most significant, and the TIFF "Magic Number" is set appropriately.

[10] All TIFF readers are equipped to import little-endian format; some tiff readers will not accept big-endian TIFF products.

## 6.3 GEOTIFF keys

The JERS SAR IPF supports two cartographic projections for geocoded products, UNIVERSAL TRANSVERSE MERCATOR (UTM) and UNIVERSAL POLAR STEREOGRAPHIC (UPS). UTM is better supported by the geotiff specification and requires fewer GEOKEYS to unambiguously define the projection.

The GEOKEYS supply information on the projection parameters, but the basic georeference is supplied by TIFF tags to define the image map corner coordinates, the corresponding pixel locations, and the pixel dimensions.

The tags used for UTM and UPS are detailed in Table 6-1 below.

### Table 6-1 TIFF TAGs and GEOKEYs

| TAG/GEOKEY Name | GEOKEY Value | Type | Function |
|---|---|---|---|
| **UNIVERSAL TRANSVERSE MERCATOR** | | | |
| ModelTiePointTag | - | TIFF | Defines corresponding pairs of map and pixel coordinates.<br>As used, the tag data defines the 4 corner coordinates in map and pixel coordinates |
| ModelPixelScaleTag | - | TIFF | Defines the pixel dimensions in map units |
| GTModelTypeGeoKey | ModelTypeProjected | GEOKEY | Specifies that a projection is used (as opposed to lat/long) |
| GTRasterTypeGeoKey | RasterPixelIsPoint | GEOKEY | As opposed to RasterPixelIsArea |
| GeographicTypeGeoKey | GCS_WGS_84 | GEOKEY | Ellipsoid |
| ProjectedCSTypeGeoKey | UTM Zone (32600+zone for Northern hemisphere, 32700+zone for Southern hemisphere | GEOKEY | Defines UTM zone |
| ProjLinearUnitsGeoKey | Linear_Meter | GEOKEY | Defines map coordinate spacing |

| UNIVERSAL POLAR STEREOGRAPHIC | | | |
|---|---|---|---|
| ModelTiePointTag | - | TIFF | Defines corresponding pairs of map and pixel coordinates.<br>As used, the tag data defines the 4 corner coordinates in map and pixel coordinates |
| ModelPixelScaleTag | - | TIFF | Defines the pixel dimensions in map units |
| GTModelTypeGeoKey | ModelTypeProjected | GEOKEY | Specifies that a projection is used (as opposed to lat/long) |
| GTRasterTypeGeoKey | RasterPixelIsPoint | GEOKEY | As opposed to RasterPixelIsArea |
| GeographicTypeGeoKey | GCS_WGS_84 | GEOKEY | Ellipsoid |
| ProjectedCSTypeGeoKey | User-Defined | GEOKEY | |
| ProjLinearUnitsGeoKey | Linear_Meter | GEOKEY | Defines map coordinate spacing |
| ProjectionGeoKey | User-Defined | GEOKEY | |
| ProjCoordTransGeoKey | CT_PolarStereographic | GEOKEY | Defines basic projection |
| ProjFalseEastingGeoKey | 2000000 | GEOKEY | |
| ProjFalseNorthingGeoKey | 2000000 | GEOKEY | |
| ProjCentreLongGeoKey | 0 | GEOKEY | Defining appropriate pole as projection centre |
| ProjCentreLatGeoKey | 90 | GEOKEY | Defining appropriate pole as projection centre |
| ProjScaleAtNatOriginGeoKey | 0.994 | GEOKEY | Secant projection for UPS |